Production of high yield kraft pulp from jute feshwa

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ABSTRACT

The demand for paper and pulp is increasing day by day, with rapid growth in the population as well as fast development in the activites of the mankind. The tropical forests, which play a vital role in controlling global environment are disappearing at a very rapid rate due to high demand for raw materials for pulp and paper production, which creates most serious global environmental problem. In India, according to the data available, we are loosing our forest at a rate of 3.7 million acres per year.

According to the report of technical groups of Development Council of pulp, paper and Allied Industries by 2000 AD, the country needs 42.5 lakh tonnes of pulp and paper Considering a mix of 30% bamboo and 70% hard wood, the requirement of bamboo and hard wood will be 26.10 and 61.31 lakh tonnes respectively. As against this requirement, the present availability of bamboo and wood is 17.0 and 11 5 lakh tonnes (air dry) respectively The vast gap between demand and supply of raw materials can be removed to some extent by using huge amount of agricultural waste or by-products, available annually without any additional efforts.

In view of this, the use of jute, mesta whole plant, jute and its wastes, jute stick which are ligno-cellulosic materials can be utilised in conventional paper machine for production of pulp, paper, newsprint and related products. Extensive research has been carried out at Jute Technical Research Laboratories (JTRL) for about three decades to find suitable technologies for making various kind of papers, newsprint, paper board etc from jute stick, jute root cutting, jute caddis, jute feshwa and jute & mesta whole plant. It is well established that good quality writing, printing and speciality papers can be made by simple process, on existing conventional paper machine, with the minimum use of energy and chemicals and yield of pulp is high in comparison to other conventional wood materials.

Introduction :

After the extraction of the jute fibre by retting process, the stick which is the core portion of the plant is obtained in quantity 1.5-2 times of the weight of jute fibre. However, after the long jute fibres have been removed, short fibres ranging 10-30 cm. in length are still adhered to the jute stick which are called jute feshwa. Farmers get good price for long strand of jute fibre 100 cm. or more, but they do not get anything for feshwa. The feshwa fibres are stripped to obtain clean stick and are mostly burned.

The amount of feshwa varies from 10-15% of the weight of jute stick. In an average harvest year, nearly 20 lakh tonnes of jute stick becomes available which should yield at least 2 lakh tonnes of jute feshwa every

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year. For a paper mill consuming 100 tonnes jute feshwa daily, yearly consumption will be 30,000-35,000 tonnes. So there is prospect that several medium size paper mills may be run based on this unconventional raw material specially in Eastern India. The material is not bulky and it can be pressed, baled and shipped in trucks like straw.

It may be mentioned that excellent work is being done at the Institute for utilisation of jute stick for production of paper (Reference 1,2). During study on pulping jute stick for dissolving grade pulp(Reference 3), it was observed that with feshwa alongwith jute stick, the pulp yield was higher. The unbleached sheet also showed higher fold endurance property than sheet from 100% jute. One local paper mill carried out extensive work in procuring the jute feshwa from the farmers and they procured several tonnes at a price of Rs. 500-600/ton. In this paper, recent work carried out on pulping study of such new raw material has been reported.

Experimental :

Pulping of Feshwa was carried out with kraft chemical in a 15 L Digester (Swedish standard) using, 0.5 to 1 kg jute feshwa. The resulting pulp was freed from alkali by washing, screened to remove undigested particles. The fibrous pulp was then cut into 2-4 cm. length, pressed into a cake and weighed. The yield of the pulp was determined by estimating water content of the pressed cake. The pulp was then subjected to beating at 3-4% consistency in a 20 L valley beater (Swedish standard, SCAN). Freeness and permanganate number of the beaten pulp was determined by TAPPI standard process and hand made sheet of 30-40 cm. size was made using standard net size, 100 mesh at 4–5% slurry consistency and was air dried.

The sheets were conditioned and tested for tensile strength and double fold by German standard machine, and Mullen. bursting strength by U.K. standard machine.

Bleaching was carried out using hypo chlorite at pH 10-11 followed by extraction with 1% alkali at a slurry consistency of 5% (1:20 solid to liquor ratio). The pulp brightness was measured by reflectance spectrophotometer, unigalv (U.K.).

Results and Discussion :

1. Low cast semi-chemical pulping :

Pulping of jute feshwa carried out at room temperature and at 90°C (open digestion) with 10% alkali. The results have been presented in Table-1. The yield was 70-75% for hot caustic and 75-80% for cold caustic. Feshwas after cold caustic treatment for 12 hours became quite tender, gave us problem in cutting to 1 cm. in length and in beating under standard condition. Of course beating period to reach 40° or 50° SR was higher with cold caustic pulp as compared to other pulp but both drainage and sheet formation were good. Tensile strength was moderate (5000-4000 m) and fold was on low side. The pulp is not bleachable but can be bleached to 55-60 brightness with 15% chlorine at PH 10-11. Such pulp may find application in village level small scale industry for hand made paper and also for ordinary low cost kraft paper.

Table—I

Semi-chemical pulping results of Jute Feshwa

	Pulp A	Pulp B
Temperature	25-27°C	95-100°C
% Chemical (NaOH)	10	10
Liquid Ratio	1 : 10	1 : 10
Time	12 hours	02 hours
Yield % (OD basis)	78	74
Beating time to reach 50° SR Freeness	70 min.	60 min.
Tensile strength (BLM)	4000	5000
Fold Endurance	56	30
Burst factor	80	55

II. Chemical pulping :-

As lignin content (Reference 4) of jute feshwa is lower than jute stick or hard wood and alfa-cellulose content is higher, it is expected that this raw material should yield a chemical pulp with lower chemical consumption.

Pulping of Feshwa fibre (uncut) was carried out with kraft chemicals ranging from 10-20% with 25% sulfidity (Reference 5). The fibre became very tender specially on increasing the chemical. The beating behaviour, even at lower concentration of alkali was satisfactory. The results of pulping condition and sheet properties have been presented in Table- II. The yield was high and % drop in yield with increase in chemical for pulping was quite modest. Permanganate number decreased sharply with increase in chemical with 20% chemical the permanganate no. was 12 with 62%yield. It is expected that at higher sulfidity (3o%) jute feshwa may yield a pulp having permanganate no. lower than 10 and such pulp be processed for rayon grade pulp. Further research along this line is in progress. The beating time to SR 50° with 5 kg. load for 0.5 kg. pulp was moderate, it decreased with increase in chemical. Good drainage was observed with all the pulp samples beaten to SR 50°. It is seen that 15% chemical is the optimum for satisfactory tensile, fold and burst factor which went down with higher chemical. Jute gunny cutting pulped with 10% chemical was found to have tensile and burst 10-20% lower than jute feshwa. Our results indicate that jute feshwa is cheaper and superior as paper making fibre than gunny cuttings straw or other similar materials.

Table—II

Kraft Pulping Results of Jute Feshwa

	Pulp		
	C	D	E
% chemical	10	15	20
Sulfidity	25	25	25
Temperature	160°C	160°C	160°C
Steam Pressure	6 kg./cm²	6 kg./cm²	6 kg /cm²
Time to 160°C	90 min.	90 min.	90 min.
at 160°C	02 hours	02 hours	02 hours
% Yield	68	64	60
Permanganate No.	28	18	12
Beating time for 50° SR	60 min.	45 min.	40 min.
Tensile strength BLM	5500	7081	7000
Fold Endurance	148	623	173
Burst factor	65	115	105

III. Bleached pulp :-

Pulp A and Pulp B are not free by bleachable type. However, they can be bleached with high amount of chlorine to light brownish shade and with two volumes of hydrogen peroxide to creamy while shade retaining a fair amount of tensile strength. The unbleached pulp should be suitable for medium quality kraft paper having burst factor about 20 for 100 GSM paper.

Pulp C, D, E made at 6 kg/cm² steam were all bleachable type but the degree of brightness varied with the amount of chemical used in pulping. There was some spots and patches in the bleached sheet in pulp C but it disappeared with increase in chemicals (15 or 20%). The origin of spots appeared to be due to presence of tiny sticks and barky matters in the feshwa. Chemical analysis showed that those tiny sticks contained 4-5% higher lignin than feshwa fibre. At lower chemical, possibly specks and barky matters are not properly cooked and its chlorine requirement also will be higher resulting in spots in the bleached sheet. At higher percentage of chemicals they are properly cooked and the effect is not seen. After removal of sticks and barky matter from feshwa, it was observed that at low chemical (10%), the shade after bleaching was quite even without any spots.

The drop in tensile strength was moderate in all pulps after bleaching but drop in fold endurance was high. The yield of the bleached pulp with brightness close to 70 was 50% with jute feshwa, the yield was much higher than jute sticks or baggasse pulp.

Table—III

Bleaching studies of Jute Feshwa Pulp beaten to SR 50

	Pulp C	Pulp D	Pulp E
Initial Permanganate No.	28	18	12.
Yield of Bleached Pulp (based on original charge)	58	53	50
Brightness	52	60	68
Tensile strength (BLM)	3500	5200	4500
Fold Endurance	75	65	2
Burst Factor	42	83	40

Conclusions :

From the study it is seen that there is a great possibility of acceptance of this raw material in Eastern region for production of pulp and paper due to (Reference 6)

a) Easy pulping behaviour

b) Lower chemical consumption

c) High yield and high fold endurance of the sheet

d) Easy availability at a moderate price

It is a seasonal product like straw and it is not bulky. It is cheaper than gunny cuttings which is sold at Rs. 800/- to Rs. 1,000/- per tonne compared to Rs. 500/- to 600/- per tonne for jute feshwa obtainable directly from farmers. If the paper mills is situated in jute growing district the transportation cost will be very moderate, Rs. 50-60/- per tonne. At a price even Rs. 600/- per tonne jute feshwa gives much higher grade pulp than straw and as good as or even better than gunny cutting, hard wood or bamboo. A medium size paper mill may use 50% straw and 50% jute feshwa in obtaining medium grade kraft or bleached sheet with economic benefit. Waste paper or rag in portion 10-20 may be mixed in the composition for improving runnability. A plant trial based on our proposition is being planned at present at a new paper mill in West Bengal. Further research is in progress to study the speck problem in bleached feshwa sheet and pulping with other conventional raw materials like bamboo, hard wood etc. by both kraft and neutral or acid sulfite process.

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